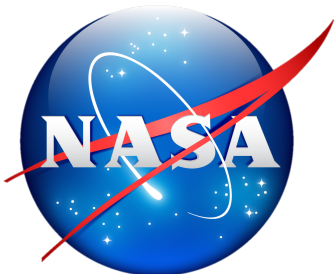


# Flux Cancellation as the Trigger of Quiet-Region Coronal Jet Eruptions

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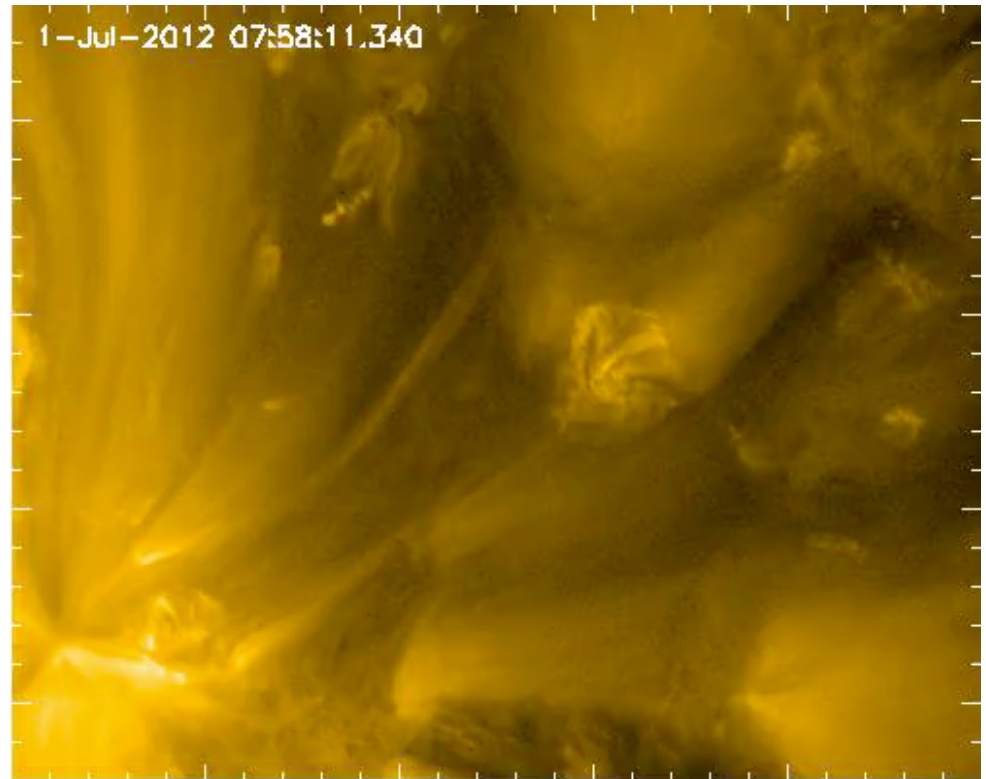
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## Introduction

- Coronal jets are frequent magnetically channeled narrow eruptions. They occur in various solar environments: quiet regions, coronal holes and active regions.
- All coronal jets observed in EUV and X-ray images show a bright spire with a base brightening, also known as jet bright point (JBP).
- Recent studies show that coronal jets are driven by small-scale filament eruptions (e.g. *Hong et al. 2011*, *Shen et al. 2012*, *Adams et al. 2014*, *Sterling et al 2015*).
- *Sterling et al. 2015* did extensive study of 20 polar coronal hole jets and found that X-ray jets are mainly driven by the eruption of *minifilaments*.
- **What leads to these minifilament eruptions?**



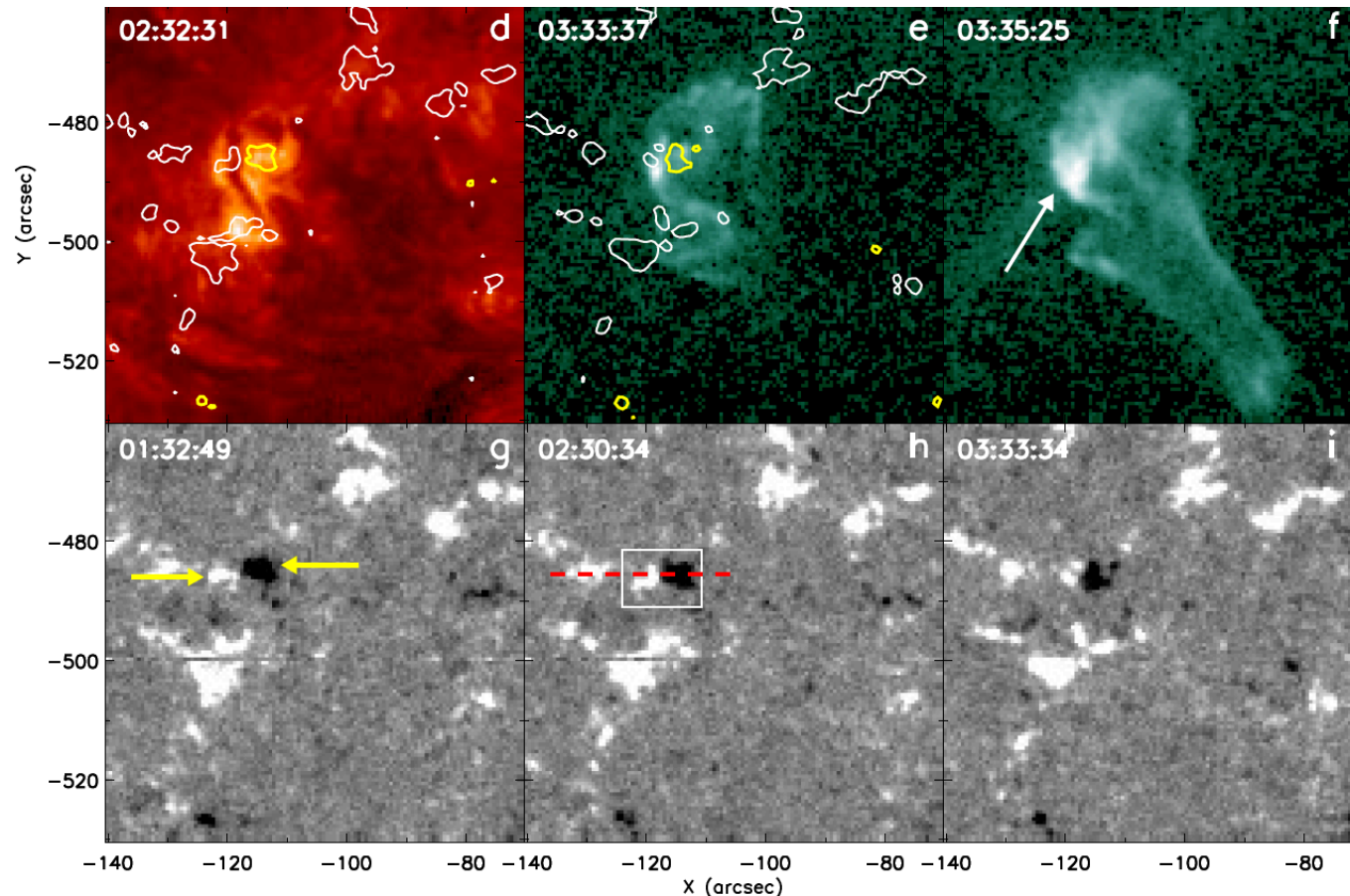
We examined the magnetic cause of 10 random on-disk quiet region jet eruptions.

Measured parameters for the observed quiet-region jets:

Event No.	Date	Time <sup>a</sup> (UT)	Location <sup>b</sup> x,y (arcsec)	Jet Speed <sup>c</sup> (km s <sup>-1</sup> )	Jet Dur. <sup>d</sup> min.	Jet-base <sup>e</sup> Width (km)	Minifil. length <sup>f</sup> (±1700 km)	Φ values <sup>g</sup> 10 <sup>19</sup> Mx	% of Φ <sup>h</sup> reduction
J1	2012 Mar 22	04:46	-470,-100	100±30	15±5	10500±500	9800	1.6	52 ± 5.8
J2	2012 Jul 01	08:32	-44, 285	100±10	10±2	27000±500	25000	4.0	18 ± 6.8
J3	2012 Jul 07	21:31	-192,-180	120±15	14±3	16500±400	10500	— <sup>i</sup>	—
J4	2012 Aug 05 <sup>j</sup>	02:20	-485, 190	140±35	10±3	22000±1000	31000	1.5	21 ± 6.0
J5	2012 Aug 10	23:03	-168,-443	125±15	15±2	16000±400	10000	0.9	57 ± 5.4
J6	2012 Sept 20	22:56	-158,-486	35±5	9±2	20000±500	36000	2.0	23 ± 4.6
J7	2012 Sept 21	03:33	-115, -485	135±30	12±1	17500±500	15000	1.0	36 ± 7.2
J8	2012 Sept 22	01:25	-338, 103	110±45	11±1	13000±600	5700	0.9	50 ± 5.1
J9	2012 Nov 13	04:21	-28,-307	55±5	9±3	18000±1000	25000	1.7	34 ± 3.2
J10	2012 Dec 13	10:36	26, 50	65±20	10±2	9500±500	12500	1.2	38 ± 5.0



## Quiet region jet (J7)

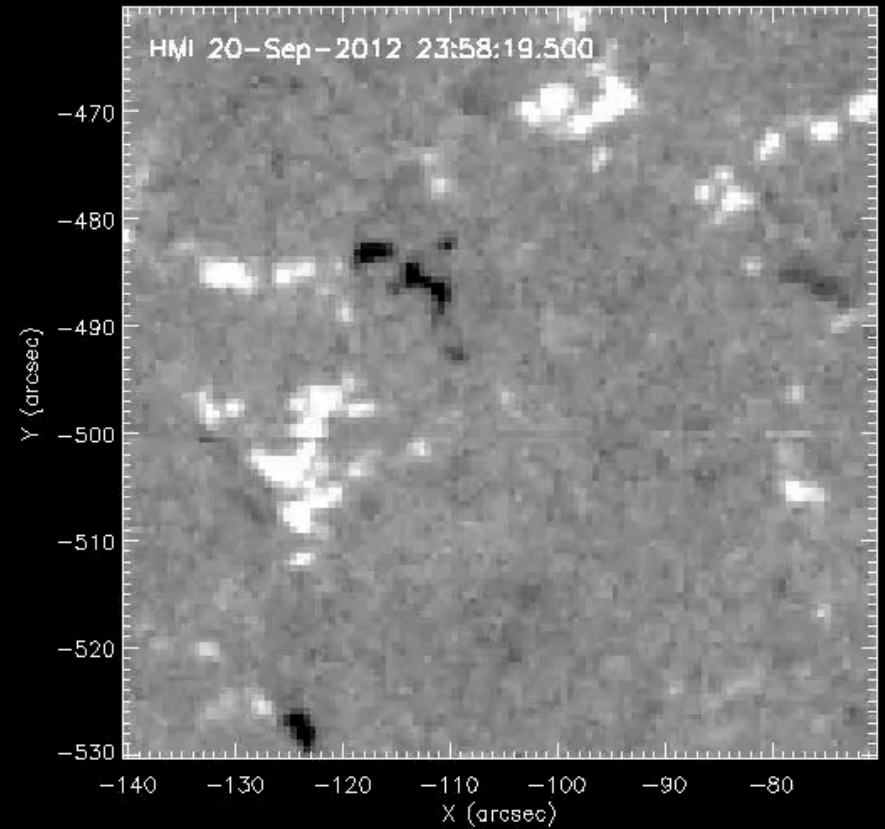
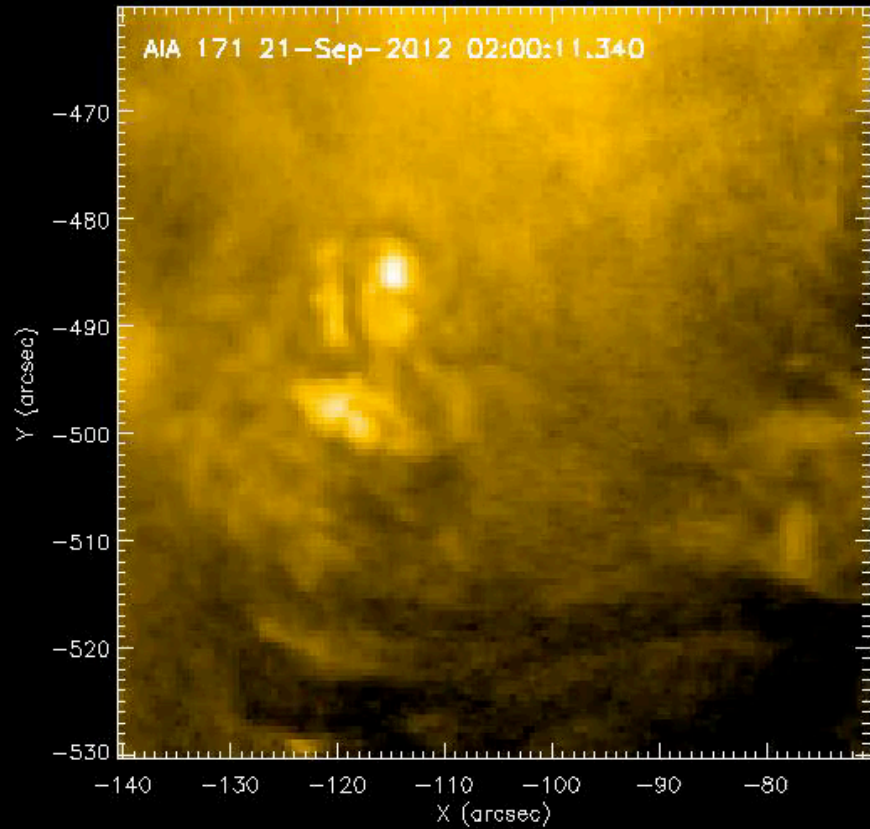


- A minifilament is present in the jet-base region prior to jet eruption.
- It resides over the neutral line between the opposite-polarity flux patches.
- The JBP occurs at the pre-eruption location of the minifilament.
- The jet spire extends upward with an average speed of  $135 \pm 30 \text{ km s}^{-1}$ .

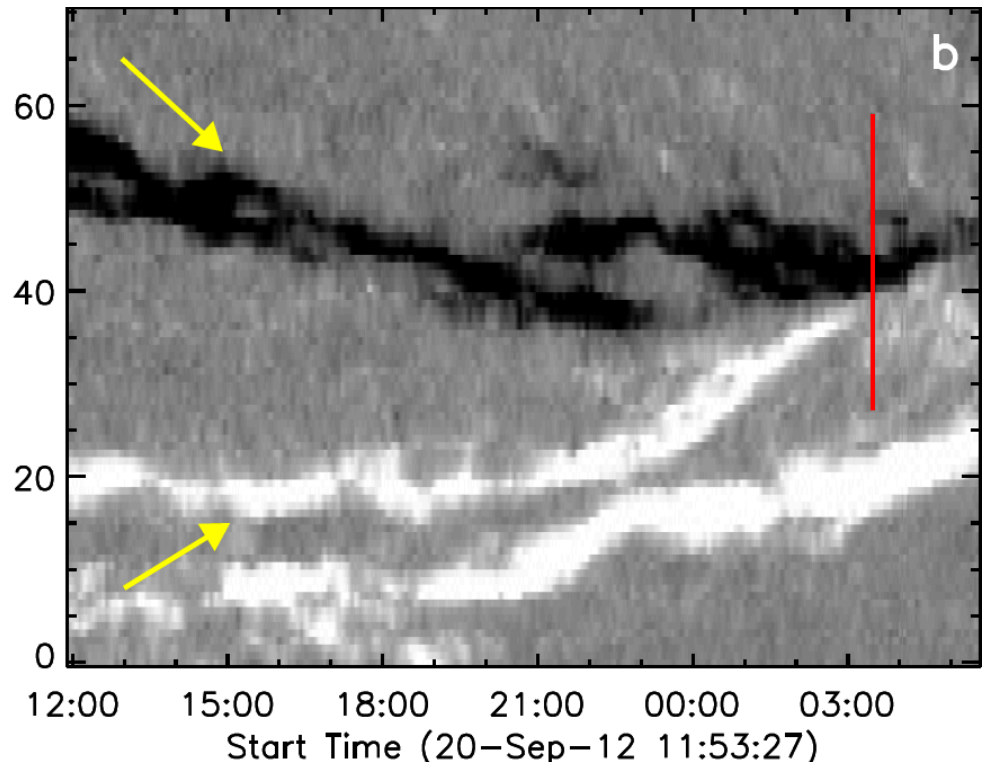
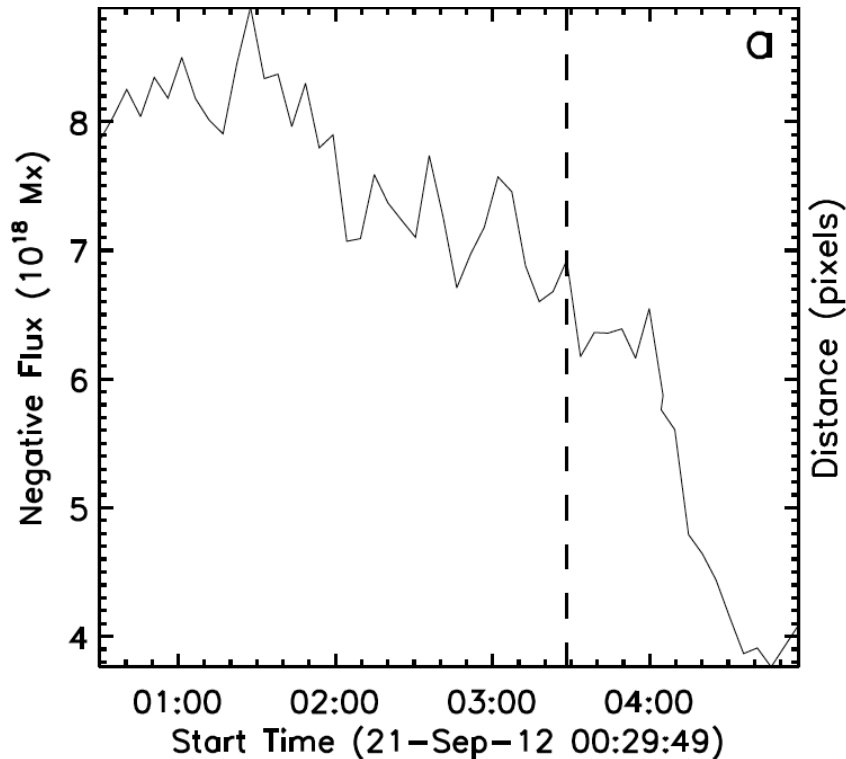
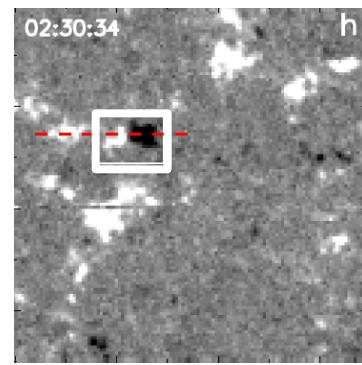




## Quiet region jet (J7)



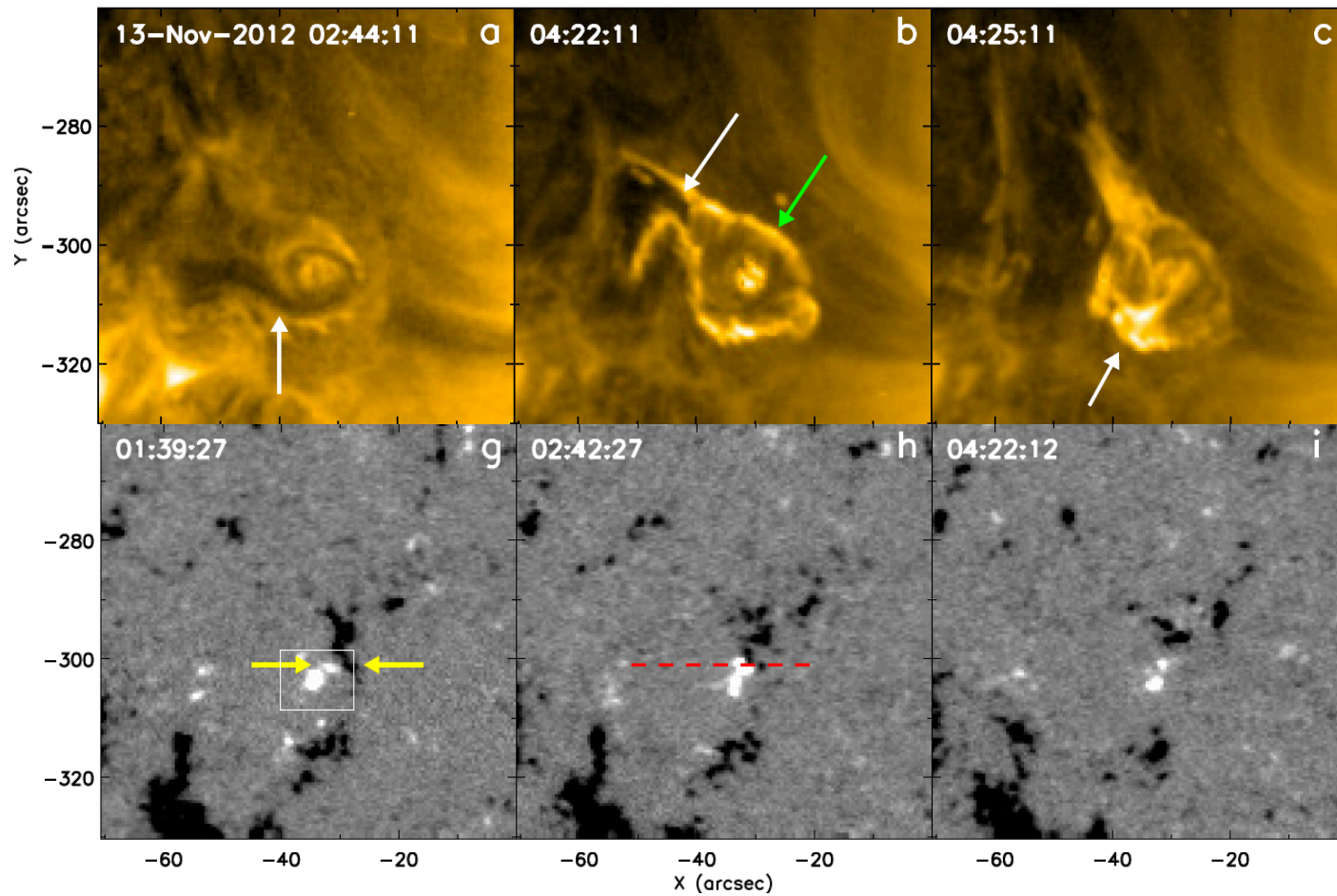
## Flux cancellation leading to minifilament eruption



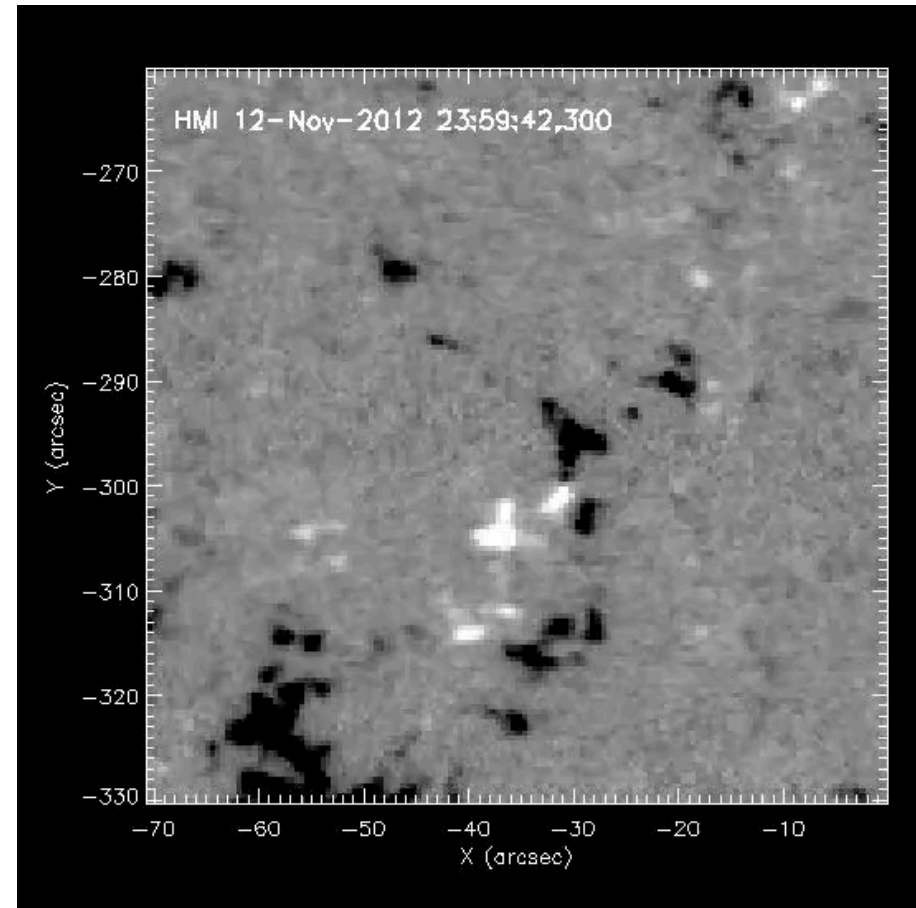
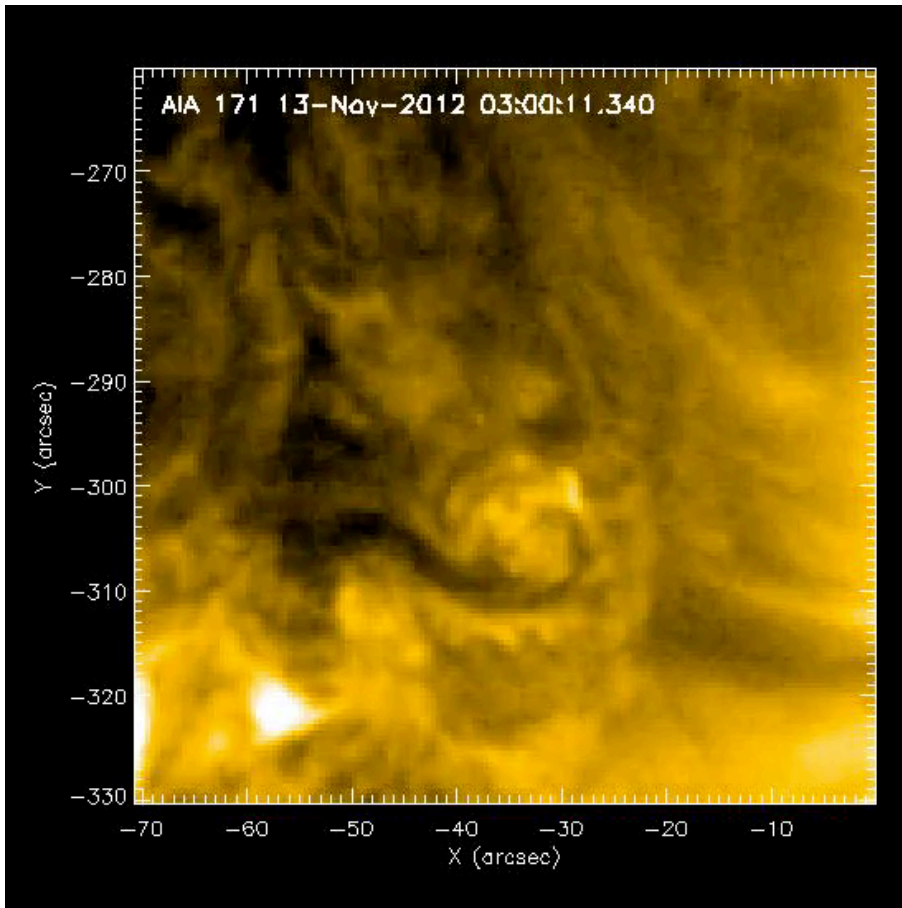
- The negative flux continuously decreases with time, which is clear evidence of flux cancellation at the neutral line of the minifilament.
- HMI time-distance map shows the convergence and cancellation of the jet-base polarities.



## Quiet region jet (J9)

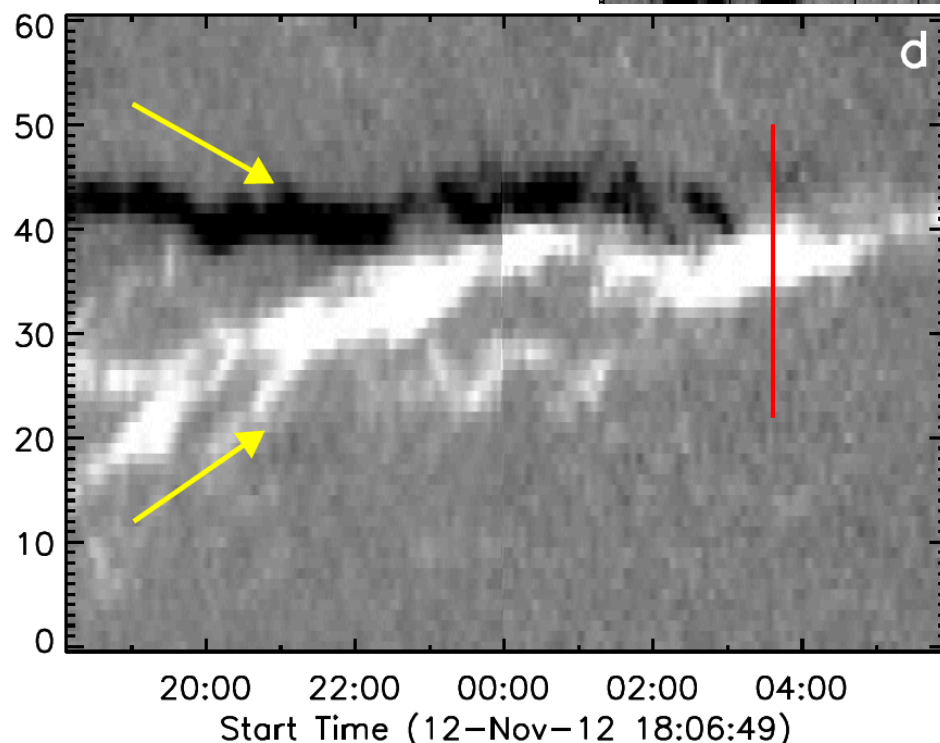
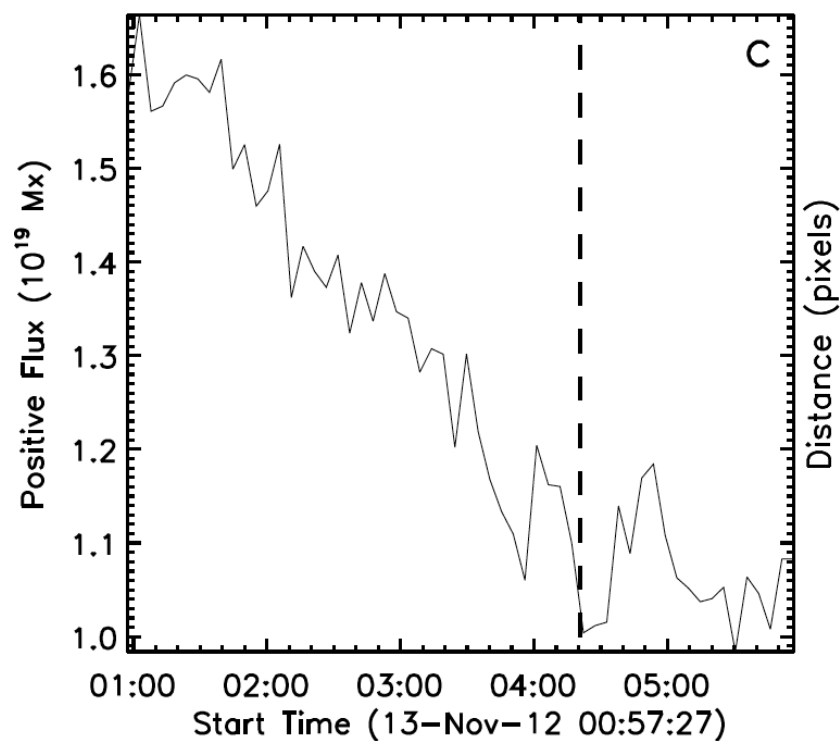
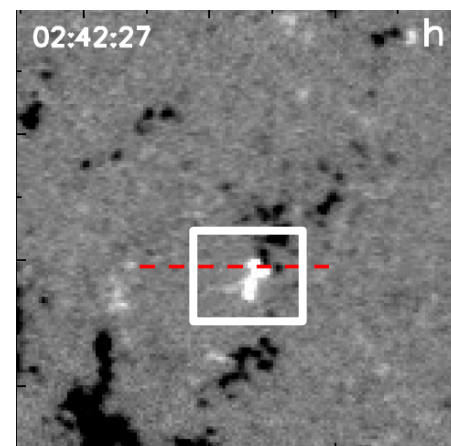


## Quiet region jet (J9)

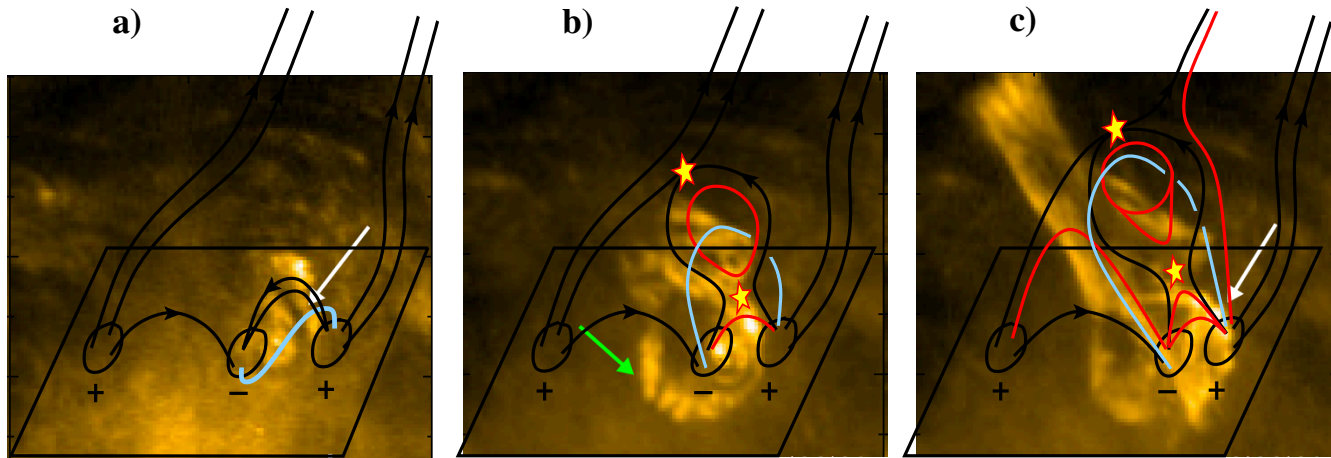




## Flux cancellation leading to minifilament eruption



## Schematic Illustration of Observations



- The minifilament (blue) initially resides in sheared/twisted field between patches of majority (positive) and minority (negative) flux.
- These two flux patches converge and cancel with each other. Continuous flux cancelation at the neutral line eventually destabilizes the filament field to erupt outwards and undergo external reconnection with the surrounding coronal field. The external reconnection opens the erupting closed field, allowing hot reconnection-heated material and cool minifilament material to escape along the far-reaching field as the jet spire.
- We find in each of the ten jets that opposite polarity magnetic flux patches converge and cancel, with a flux reduction of 20-60 % until jet erupts.



## Summary

- We examined in detail ten random on-disk quiet-region jets.
- In each event a cool-transition-region material, a minifilament' initially resides at a neutral line inside the jet-base region.
- Our observations suggest that flux cancelation is usually the trigger of quiet-region coronal jet eruptions.
- All the jet-producing eruptions are similar to typical solar flare eruptions, where a solar flare arcade forms during the filament eruption along the neutral line along which the filament resided prior to its eruption.

